

## 5. GEOGRAPHY AND ECOLOGY OF COSMOLEDO ATOLL

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### Introduction

Cosmoledo Atoll, 9°41'S, 47°35'E, is located 110 km east of Aldabra. It consists of eight main islands and numerous islets on the atoll rim, surrounding a large and open lagoon. The two largest islands, Wizard and Menai, are those usually visited by scientists. There has been no detailed survey of Cosmoledo at any time, though many expeditions have called there for brief visits (Table 4). The main published accounts are those by Dupont (1907, 8-12), Fryer (1911, 428-430), Travis (1959, 111-156), Baker (1963, 86-92), and Piggott (1961, 27-30; 1968, 53-54). Ten members of the Royal Society Expedition to Aldabra visited Menai and Wizard Islands in March 1968, and five more visited Menai only in September 1968: this paper summarises earlier work and adds new information from the Royal Society surveys.

The main hydrographic survey of Cosmoledo was by W. J. L. Wharton in 1878, published as Admiralty Chart 718 in 1879. This chart, with revisions by H.M.S. Owen in 1964, is still current. The atoll was covered by aerial photography in 1960, and Baker (1963, 87, 89, 91, 93) used air photographs to prepare sketch maps of the geology of the main islands. Figure 3 is based primarily on the 1960 air photograph cover, with topographic control and bathymetry from the 1967 edition of Admiralty Chart 718. This map should not be used for navigational purposes without further field survey.

### Geomorphology

Cosmoledo stands on the northern of two presumably volcanic peaks, 45 km apart, rising from the ocean floor at 4000-4400 m depth. At the 4000 m isobath the volcanic massif is 85 km long N-S and 33-52 km wide: the Cosmoledo peak becomes distinct from that on which Astove stands at a depth of 1000 m (Figure 4). Outside the peripheral reef of Cosmoledo, the sea floor falls gently to 50 m, over a distance of 0.5-1 km, and then more steeply: the 500 m isobath generally lies 1-1.5 km from the surface reefs.

The atoll has maximum dimensions of 14.5 x 11.5 km, and a total area of 152 sq km. The peripheral reef flat varies in width from 1 to 2.5 km, averaging about 1.5 km, and encloses a shallow lagoon, opening to the south in two major channel systems. The greatest depths in the lagoon

Table 4. Scientific Studies at Cosmoledo Atoll

<u>Date</u>	<u>Study</u>	<u>Reference</u>
1822 July 31	Capt. F. Moresby in ships <u>Wizard and Menai</u>	Moresby (1822)
1875 Oct. 17	Capt. <u>Niejahr, Hermann</u> <u>Friedrich</u>	Niejahr (1876)
1878	<u>Hydrographic</u> survey by W. J. L. Wharton	Adm. Ch. 718 (1879)
1895	Agricultural survey by S. C. E. Baty	Bergne (1900)
1901 Oct. 9-12	Visit by H. A'C. Bergne	Bergne (1901)
1906	Chart emendations by L. Ferrari	
1907	H. L. Thomasset, insects	
1908 Sept. 1-5	J. C. F. Fryer: general observations, insects	Fryer (1911, 428-30)
1906 Sept. 14-19	R. Dupont: plants, insects	Dupont (1907, 8-12)
1937 Sept.-Nov.	L. D. E. F. Vesey-FitzGerald: vegetation, birds	Vesey-FitzGerald (1940,1941,1942)
1953 Nov.	Italian Zoological Expedition: C. Prola, F. Palombelli, F. Prosperi, S. Nievo	Berio (1956)
1956	H. Legrand: Lepidoptera	Legrand (1965)
1957 Dec. 10-12	W. D. Hartman: land birds	Hartman (1958)
1959 Oct.9-Nov.27	H. Legrand, M. Gerber: Lepidoptera	Legrand (1965)
1960 Oct.9-12	B. H. Baker, geology; C. J. Piggott, soils	Baker (1963); Piggott (1961,1968)
1964	R. E. Honegger: birds, reptiles	Honegger (1966, unpub. a, unpub.b)
1964 March 13-14	H.M.S. <u>Owen</u> ; Cmdr D. W. Haslam: survey, birds	Bourne (1966)
1967 Oct. 5-6	M. D. Gwynne, D. Wood, I. S. C. Parker: plants, birds	Parker (1970); Gwynne and Wood (1969)
1968 March 6	C. W. Benson, B. H. Cogan, A. W. Diamond, F. R. Fosberg, J. Frazier, A. Graham, P. Grubb, A. Hutson, K. McKenzie, S. A. Renvoize	This report; Benson (1970); Fosberg and Renvoize (1970)
1968 Sept. 14	C. J. Bayne, J. C. Gamble, M. E. D. Poore, D. R. Stoddart, T. S. Westoll	This report



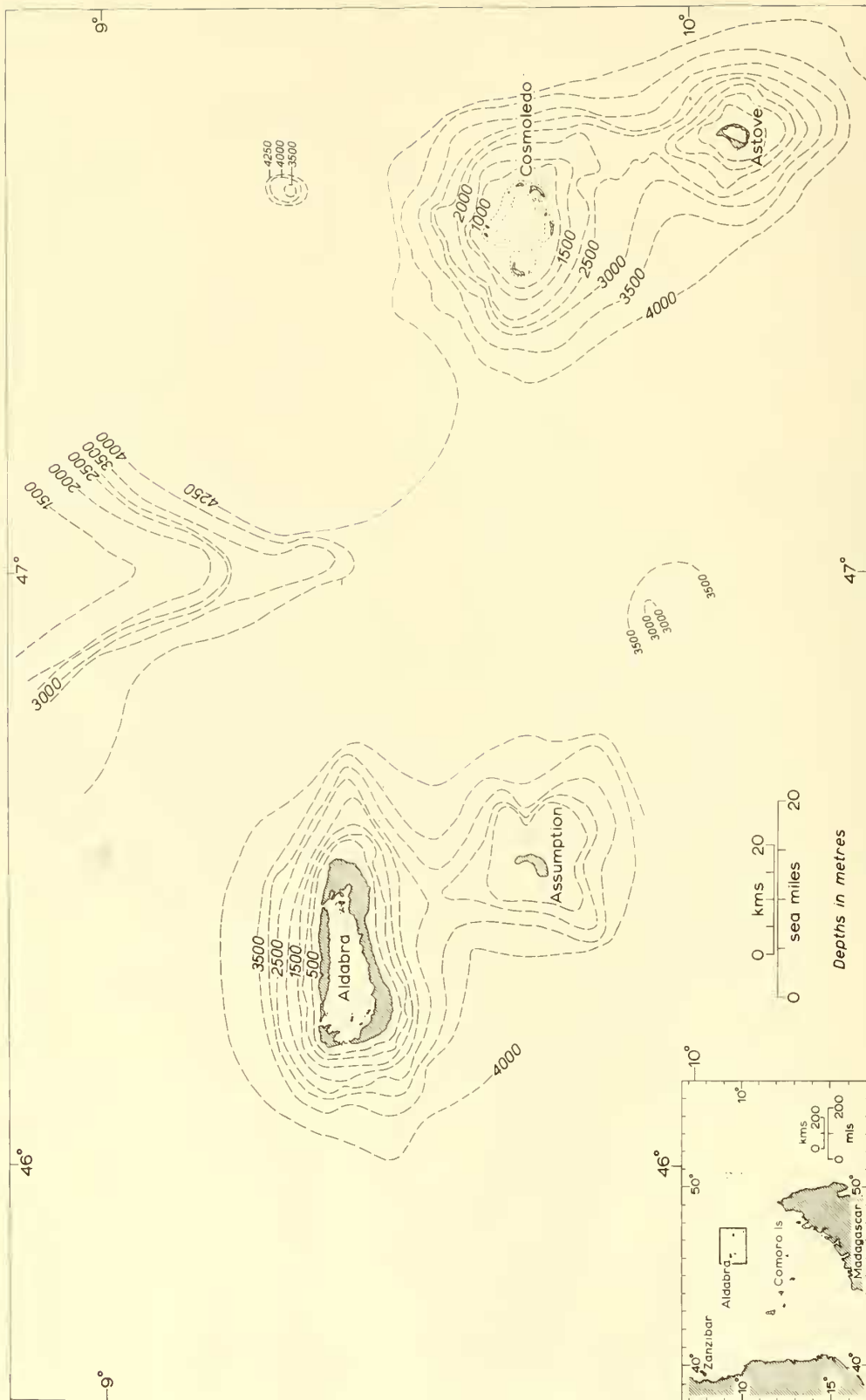


Fig. 4. The Aldabra Group

are found at the inner ends of these two channels and in the channels themselves, though where these bifurcate and disappear there is much coral growth between the branches with depths of less than 1 m. Most of the central lagoon basin is more than 5 m deep; a small area at the head of the southwest channel reaches more than 6 m, and a larger area at the head of southeast channel more than 7 m. Maximum recorded depth is 8.2 m. Coral growth is important only around the branching channel systems and also where the lagoon narrows towards Menai Island, here forming a reticulate reef network similar to that at Hitaddu, Addu Atoll. Irregularities on the lagoon floor can be seen on air photographs, but the general simplicity of form and absence of knolls and patches contrasts markedly with the Farquhar lagoon. Maximum depths in the main channels range from 5 to 11 m; other passages through the peripheral reef which are navigable by small boats do not intersect the reef flat itself, and have depths of 1 m or less.

There are eight main islands on the atoll rim, with numerous small islets; the total land area is approximately 5.2 sq km, or 3.4 per cent of that of the whole atoll. Wizard Island (Grande Ile), on the windward side of the atoll, is 3.2 km long and has an area of 1.6 sq km. It consists of low elevated reefrock largely covered with sand and gravel, and with coastal dunes on the seaward side up to 17 m high. The crests of these dunes are aligned parallel to the prevailing Trades, and Baker (1963) states that reefrock pavement is exposed in the dune slacks. The seaward beach, at least in the centre, consists of sand and cobbles overlying a smooth inclined rock pavement, rising from a potholed and eroded reef flat. The central part of the island is formed by a sand plain, and the lagoon shore is a gently sloping sand beach with, in places, ledges of reef limestone.

Menai Island on the lee side has a land area of 2.3 sq km. The area of raised reefrock is larger than on Wizard. On the seaward side the rock reaches 2-4 m in height, forming undercut headlands separated by sandy beaches. The rock declines in height to about 1 m on the lagoon side, where there is a large area of mangrove. Several dune areas are located between the reefrock and the mangrove, and the dunes at the south point, about 8-10 m high, are still active. Older vegetated dunes at the north end rise to 10-15 m. On the seaward side the raised reefrock is partly covered with sand, and north of the settlement the old undercut cliffline is fronted by a wide area of recent sand. The elevated reefrock at the south point is a massive reef limestone with much Acropora; it resembles the main Aldabra limestones but there is no inland ridge at about 8 m as on Aldabra. There is probably no basis in fact for Niejahr's (1876, 244) report of lava blocks on Menai.

The other islands of the atoll rim were not visited by Royal Society parties, but Piggott (1961) visited North, Grand Polyte, Pagoda and South Islands. North Island he describes as being formed entirely of eroded champignon, with some sand on the south side, the whole formerly covered with guano, now largely scraped away and remaining only in holes. Grand

Polyte, about 250 m wide, is formed in the north of raised reefrock standing about 1.6 m above high water, and in the south of sandy flats; central dunes rise to about 5 m. South Island, about 200 m wide, consists entirely of raised reef limestone.

The soils of the Cosmoledo islands can be classed into Piggott's (1968) main soil series: most of the islands, especially on rock, are covered with phosphatic Desnoeuvs Series with a very shallow A horizon; Farquhar Series soils are forming on dunes; and in some areas there are soils approximating to Shioya Series, but always mixed with dune sands.

### Vegetation

The flora of Cosmoledo is similar to that of Aldabra, and plants collected in 1968 and by Gwynne and Wood (1969) in 1967 are listed by Fosberg and Renvoize (1970). Three main vegetation types can be distinguished: (1) raised reefrock vegetation; (2) sand vegetation, including dunes; and (3) mangrove vegetation. The raised reefrock vegetation has some of the species present on Aldabra, and notably Pemphis, Sideroxylon and Ficus, with Sarcostemma, but the small area, degree of human interference, and lack of investigation combine to explain the absence in recent records of such characteristic species as Lomatophyllum and Solanum. Sand vegetation has been much affected by man, except for the littoral vegetation of Scaevola, Tournefortia and Suriana. Most of the sand areas, except the dunes, support coconuts, with a ground cover of grasses, sedges, herbs and vines, including many introduced weeds and cultivated species. Stable dunes are covered either with Casuarina woodland or with a scrub of Scaevola and Suriana. The mangrove vegetation is tall and includes at least six species: Avicennia marina, Rhizophora mucronata, Bruguiera gymnorhiza, Sonneratia alba, Xylocarpus granatum and Ceriops tagal. Apart from the extension of coconut woodland and attendant introduction of aliens on the sand areas, and the clearing of reefrock vegetation during guano digging on the North Island, the vegetation of Cosmoledo has probably changed little since Moresby (1822, 30) recorded that "here we saw a few Cocoa Nut trees, the Mapou Pisonia, some Latannia, and trees that resemble the Filahoe Casuarina of the Mauritius".

Recent observations of vegetation are available only for Menai and Wizard Islands. Piggott (1961) mentions a mixed scrub with Pemphis and much wild cotton on raised reefrock at North Island, with Scaevola on recent sand. He again found a Pemphis scrub on reefrock on Grand Polyte, and the same species on the dunes and also on the southern sand flats, together with Scaevola and Tournefortia. On the raised reefrock of South Island he describes "a few Pemphis and Pisonia grandis (mapou) shrubs but little other vegetation".

## Menai Island

The seaward shore of Menai has a characteristic beach-crest hedge of Scaevola taccada, Tournefortia argentea and Suriana maritima, with Cordia subcordata on the landward side of the hedge. Pemphis acidula is found on rocky headlands. The vegetation of the sandy area north and south of the settlement is most diverse. Cocos nucifera is common though patchy in its distribution. Tall Casuarina equisetifolia is found at the settlement itself; this species was noted by Moresby in 1822, and Fryer (1908) found it "apparently of great age" sixty years ago. Guettarda speciosa, Cordia subcordata, Thespesia sp., and Grewia salicifolia are the only other trees noted. Scattered shrubs are more numerous near the southern end of the island, where they include Allophylus africanus (3 m tall), Premna obtusifolia (4 m), Azima tetracantha, Acalypha claoxyloides, and Caesalpinia major; north of the settlement we also noted Vernonia aldabrensis. The ground cover is very diverse. North of settlement Fimbristylis cymosa is dominant; to the south there is a cover of grasses (Eragrostis sp., Dactyloctenium aegyptium, Lepturus repens), sedges (Fimbristylis cymosa, Cyperus ligularis), the vine Cassytha filiformis, and a number of flowering plants, including Launaea intybacea, L. sarmentosa, Ipomoea pes-caprae, Boerhavia repens, Pleurostelma cernuum, Passiflora suberosa, Euphorbia sp., Sida parvifolia, Evolvulus alsinoides, Hypoestes aldabrensis, Cleome strigosa and Asparagus umbellulatus.

At and near the settlement other species are found. These include cultivated trees Moringa oleifera, Terminalia catappa and Carica papaya, decoratives such as Pedilanthus tithymaloides, Catharanthus roseus and Solanum melongena, and a number of other introductions, such as Agave, Gossypium hirsutum, Ricinus communis and Panicum maximum. Maize is also cultivated.

The sand dune vegetation varies with the age and stability of the dune. The active southern dunes are covered with clumps of the sedges Fimbristylis cymosa and Cyperus ligularis, and patches of the grass Dactyloctenium aegyptium. On the lower dunes there is a mosaic of the shrubs Scaevola, Tournefortia and Suriana; two trees of Pisonia grandis nestle in the lee of the southernmost dune, as they do in the lee of Dune Jean-Louis on Aldabra. The northern dunes are most subdued and closely vegetated, with an open woodland of Casuarina, scattered shrubby growths of Colubrina asiatica and Turnera ulmifolia, and a surface cover with much Fimbristylis, together with Eragrostis sp., Dactyloctenium aegyptium, Crotalaria laburnoides and Achyranthes aspera.

The lagoon sand beach, where not directly colonised by mangrove, is a narrow ledge with low Scaevola, Tournefortia and Suriana, with such plants as Tribulus cistoides and Portulaca oleracea. At the north end Sesuvium portulacastrum forms a thick mat between the beach proper and the mangrove zone.

The mangrove vegetation has not been examined in detail. At the north end it consists of mature Avicennia marina and Rhizophora mucronata 10-15 m tall; at the south end of an outer zone of Avicennia, much of it dying, apparently because of the burial of pneumatophores by sediment, together with Rhizophora and Sonneratia alba. Bruguiera gymnorhiza and Ceriops tagal are found in open inlets south of the settlement, lagoonward of the raised reefrock.

The champignon zone was crossed north of the settlement, where it is not very deeply dissected. Euphorbia abbotti was not seen, though previously reported from the atoll. The vegetation of shrubs (Pemphis acidula, Sideroxylon inerme) and a tree (Ficus thonningii) is 2-3 m high. Sarcostemma viminale is abundant (but curiously not Plumbago aphylla, also previously recorded), together with the low, spreading woody shrub Salvadora angustifolia.

#### Wizard Island

Less is known of the vegetation of Wizard than of Menai. The seaward beach has a scrub of Scaevola and Suriana, with a ground cover of Sporobolus virginicus, Launaea sp., and Euphorbia sp. The dunes have a dense growth of Tournefortia argentea, 1-2 m tall with about 30 per cent dead wood, and Suriana maritima. Sporobolus is not common on the dunes, where the ground cover consists of clumps of Fimbristylis, rosettes of Eragrostis, and Boerhavia.

Between the seaward dunes and the lagoon coast there is a meadow of Dactyloctenium 0.5 m thick, extending up to a line of Agave at the foot of the dunes. This central plain also includes Ipomoea, Achyranthes, Boerhavia, Microstephanus, Plumbago aphylla, Solanum nigrum, species of Portulaca, Sporobolus virginicus, Cassytha, Cassia occidentalis, and a very few dwarf Sideroxylon and Premna. Near the lagoon beach, there is a belt of tall scrub, which is less diverse than similar communities on Aldabra. It includes Acalypha, Azima, Achyranthes, Thespesia populneoides, Allophylus, and Ipomoea pes-caprae. The first three of these species tend to be locally dominant, the Azima reaching up to 3 m in height. Achyranthes is the commonest species, often forming pure stands in which Blue-faced Boobies nest, and in places extending up to the top of the lagoon shore dunes. Vines of Ipomoea tuba drape many of the shrubs.

South of the tall scrub is an area of extremely uneven champignon. The vegetation is dominated by Pemphis, with Ipomoea tuba and Cassytha. Other species noted include Phyllanthus, Acalypha, Achyranthes and Abutilon. Red-footed Boobies nest in this champignon scrub, which appears to be very little disturbed by human activities.



A coastal woodland on the lagoon shore includes moderate-sized mangroves, mostly Avicennia but also Xylocarpus. Other trees include Pisonia, Abutilon, Cordia, and the shrubs Suriana and Pemphis.

#### Fauna other than Birds

Little is known of the marine fauna of Cosmoledo, though it is probably similar in composition and zonation to that of Aldabra. Marine animals were collected in the boulder zone at the edge of the reef flat immediately south of Menai settlement, on a small cliffed promontory close to the village, and to the south of it. In the first area the fauna was rather limited, and hermit crabs were the most conspicuous animals, although on the edge of the reef flat the fauna resembled the inshore fauna under boulders at West Island settlement, Aldabra. The champignon promontory rose steeply, and while not heavily pinnacled, had rock pools nearly 1 m in diameter. The fauna resembled the spray-zone fauna on the top of cliffs on the south coast of Aldabra, and included Nerita textilis, Littorina, Crassostrea cucullata, and several species of grapsid crabs. From this promontory southwards the cliffs are colonised by chitons, dorid nudibranchs, barnacles and small prosobranchs. The reef flat is covered with marine angiosperms, and coral growth on the edge is not luxuriant. Animals noted on the lagoon beach at Wizard include Grapsus tenuicrustatus, Ocypode ceratophthalma, Coenobita perlatus, C. rugosa and Acanthopleura brevispinosa. Table 5 lists marine mollusca collected on Cosmoledo by P. Grubb in 1968 and identified by J. D. Taylor, and Table 6 Decapod Crustacea, also collected by Grubb and identified by Taylor; both collections are now in the British Museum (Natural History).

Turtles nest on Cosmoledo. On Wizard, the central part of the seaward beach, for a distance of about 100 m, is riddled with at least 50 turtle pits, though there was no sign of turtle activity on the lagoon beach. There is a turtle pen on Menai north of the settlement. Before the August 1968 Green Turtle Protection legislation, at least two Green Turtle were taken each month for food, according to the Manager, and Hawksbill were taken for export.

The terrestrial fauna, so far as is known, is a small one. Land mollusca are represented by two (possibly three) species collected by Thomasset (Connolly 1925). Land crustacea, apart from some of the species listed in Table 6, include Birgus latro, reported by Honegger (no date) on Wizard, Grand Polyte and South Islands, and Cardisoma carnifex. The reptile fauna formerly included the Giant Land Tortoise Geochelone gigantea. The date of its extinction is not known, nor do we know of any historical account of it still living, but Fryer (1911) reports finding fossil eggs in the champignon. There are three other reptiles (Boulenger 1911). Ablepharus boutonii has been recorded from Wizard and Menai; none were seen on Menai in 1968, though it was common on Wizard. Hemidactylus mercatorius occurs on both islands, and was seen on Menai in 1968. Phelsuma abbotti was seen in 1968 on

Table 5. Mollusca collected on Cosmoledo Atoll, 1968

Gastropoda

<u>Monodonta australis</u> Lamarck	<u>Thais aculeata</u> Deshayes
<u>Turbo marmoratus</u>	<u>T. hippocastanum</u> (Linnaeus)
<u>Phasianella aethiopica</u> Philippi	<u>T. tuberosa</u> (Röding)
<u>Nerita albicilla</u> Linnaeus	<u>Engina mendicaria</u> (Linnaeus)
<u>N. plicata</u> Linnaeus	<u>Cantharus undosus</u> (Linnaeus)
<u>N. textilis</u> Dillwyn	<u>Chrysame fraga</u> (Quoy and Giamard)
<u>Littorina undulata</u> Gray	<u>Strigatella acuminata</u> (Swainson)
<u>Cerithium echinatum</u> Lamarck	<u>S. litterata</u> (Lamarck)
<u>Hipponyx conica</u> Schumacher	<u>S. paupercula</u> (Linnaeus)
<u>Lambis lambis</u> (Linnaeus)	<u>Imbricaria filum</u> (Wood)
<u>Strombus gibberulus</u> Linnaeus	<u>Oliva episcopalis</u> Lamarck
<u>S. mutabilis</u> (Swainson)	<u>Vasum turbinellus</u> (Linnaeus)
<u>Cypraea arabica</u> Linnaeus	<u>Conus arenatus</u> Hwass
<u>C. caputserpentis</u> Linnaeus	<u>C. chaldeus</u> Röding
<u>C. carneola</u> Linnaeus	<u>C. ebraeus</u> Linnaeus
<u>C. caputdraconis</u> Melvill	<u>C. flavians</u> Lamarck
<u>C. helvolis</u> Linnaeus	<u>C. musicus</u> Hwass
<u>C. histrio</u> Gmelin	<u>C. tessulatus</u> Born
<u>C. lynx</u> Linnaeus	<u>Terebra affinis</u> Gray
<u>C. moneta</u> Linnaeus	<u>T. cerithina</u> Lamarck
<u>C. tigris</u> Linnaeus	
<u>C. vitellus</u>	<u>Amphineura</u>
<u>Cymatium nicobaricum</u> (Röding)	<u>Acanthopleura brevispinosa</u>
<u>C. pileare</u> (Linnaeus)	(Sowerby)
<u>Drupa ricinus</u> (Linnaeus)	<u>Bivalvia</u>
<u>Morula granulata</u> (Duclos)	<u>Isognomon dentifer</u> (Krauss)
<u>M. uva</u> Röding	<u>Donax faba</u> (Gemlin)

Collected by P. Grubb; identified by J. D. Taylor; incorporated into the collections of the British Museum (Natural History), accession number 2213. All species were collected on the beach of Menai Island.

Table 6. Crustacea (Decapoda) collected on Cosmoledo Atoll, 1968

Wizard Island

Ocypode ceratophthalma (Pallas): 1♂ Leptodius quinquedentatus (Krauss): 4♂

Menai Island

Grapsus tenuicrustatus (Herbst): Petrolisthes lamarckii (Leach)  
2♂, 2♀ Pagurus pedunculatus (Herbst)  
Geograpsus stormi (de Man): 1♂ Clibanarius striolatus (Dana)  
Eriphia laeuimana (Guerin): 1♂ Calcinus laevimanus (Randall)  
Epixanthus frontalis (Milne Edwards): 3♂ Coenobita rugosus (Milne Edwards)

Collected by P. Grubb; identified by J. D. Taylor; incorporated into the collections of the British Museum (Natural History).

Menai but not on Wizard; it is more brightly coloured than the Aldabra Phelsuma. Honegger (1966) distinguished P. abbotti menaiensis on Menai and P. abbotti subsp. on Wizard, Grand Polyte and South Island.

Insects were collected on Cosmoledo by Fryer in 1908, and forty species are recorded in the Percy Sladen Expedition Reports; these records are keyed in Table 7. Of these, only two species were Lepidoptera. Legrand's (1965) collections of Lepidoptera on Menai totalled 70 species, including 1 new genus, 24 new species, and 3 new subspecies, mostly Microlepidoptera, though some of these may need revision. B. H. Cogan and A. Hutson made a transect of Wizard Island in March 1968, collecting insects on a transect at the narrowest point between lagoon and seaward shore. Insects were abundant in number if not in variety, but unlike Astove only the smaller species appeared to be well represented. Many of the larger species were apparently scarce, perhaps as a result of the lack of permanent fresh water. Acridid grasshoppers were present in some numbers, and females of the large Cyrtacanthacris tatarica tatarica L. were common. Butterflies and Odonata were nowhere common, and the small Lycaenid Syntarucus pirithous L. was the only species to be seen in any number. The morning visit to Wizard was followed in the afternoon by 3-4 hours on Menai, but because of rain the collections were totally unrepresentative of the fauna there. The only insect of note recognised in the collections so far is a species of Pipunculid fly, the first record of this interesting parasitic family of Diptera in the Aldabra group. Most of Legrand's collecting was carried out on Menai, and the 1968 collections may be the first on Wizard. Cosmoledo has a small faunal element that it shares with Astove and none of the other islands in the

Table 7. Insects recorded from Cosmoledo Atoll  
by the Percy Sladen Expedition

<u>Group</u>	<u>Number of species</u>	<u>Reference</u>
Orthoptera	11	Bolivar (1912, 1924)
Dermaptera	1	Burr (1910)
Hemiptera	8	Distant (1913)
Lepidoptera	2	Fryer (1912)
Coleoptera	11	Champion (1914), Gebien (1922), Schenkling (1922), Scott (1912, 1926), Sicard (1912)
Hymenoptera	5	Cockerell (1912), Turner (1911)
Diptera	1	Lamb (1922)
Odonata	1	Campion (1913), Blackman and Pinhey (1967)

group, for example a Dolichopodid fly genus Sciapus sp. n. and a Trypetid fruit fly Coelotrypes vittatus. The majority of species, however, found on Cosmoledo are found throughout the Aldabra group of islands.

### Birds

The bird fauna of Cosmoledo is smaller than that of Aldabra and has attracted little attention. Earlier treatments are those of Fryer (1911), Vesey-FitzGerald (1940, 1941), Hartman (1958), Bourne (1966), and Watson and others (1963). Benson (1970a) deals in detail with the land and shore birds in the following chapter, drawing on the earlier literature and on collections and observations made during the Royal Society visits and from that by I. S. C. Parker.

Of the seven recorded land birds, only two are common: Cisticola cherina, which Benson believes to be native and not introduced, and, less abundant, Nectarinia sovimanga. Hartman (1958) reported Zosterops maderaspatana to be common on Menai; the March 1968 party did not see it at all, though Stoddart and Poore saw it on Menai in September. Two land birds are probably extinct, the flightless Rail Dryolimnas cuvieri and the Turtledove Streptopelia picturata. Abbott (in Ridgway 1895) and Fryer (1911) both reported the existence of a rail on Cosmoledo, the latter specifying South Island, though he did not land there and observe it. It is possible but very doubtful that both Dryolimnas and Streptopelia both still survive on South Island. Two other land birds are recorded: Geopelia striata was seen briefly by Benson, and there are a few crows Corvus albus. Possible resident shore birds, all seen in 1968, are Ardea cinerea, Egretta garzetta, Bubulcus ibis, and Butorides striatus. Benson (1970a) lists a dozen migrants recorded from the atoll. This paucity in species (seven true land birds at most, plus four possibly resident shore birds) contrasts with the eighteen species of land birds recorded for Aldabra. Endemism is also low, though Benson (1970b) has discussed a well-marked subspecies of Nectarinia sovimanga, only otherwise known on Astove.

Sea birds have been briefly noticed by several previous workers, notably Dupont (1907), Vesey-FitzGerald (1941), Honegger (unpublished), Gaymer (unpublished), and observers on H.M.S. Owen in 1964 (Bourne 1966). Diamond visited Wizard in the morning and Menai in the afternoon of 6 March 1968. Three species nest in large numbers on Wizard: Sula dactylatra, Sula sula and Sterna fuscata. At least 200 pairs of White Booby S. dactylatra were occupying clearings in the long grass on the west side of the island or on the dune ridge to the east. Most were displaying at empty nest sites or in apparently inactive attendance at past sites. Only five occupied nests were found, four with single eggs and the other with two. There were also two fully-feathered juveniles, both of which regurgitated large flying-fish (probably Cypsilurus sp.). On Ascension Island in the Atlantic, Dorward (1962) found that territories of this species were defended outside the breeding season, and that

although eggs were laid in most months of the year there was a marked peak of laying in one or two months. He found the incubation period to be 42-46 days, and fledging to take about 120 days; so that the near-fledged chicks found on Wizard in March would have come from eggs laid in the previous October. The eggs found would have been laid in the previous six weeks, and there were no younger chicks; hence, as the great majority of the birds had neither eggs nor young, the main laying period must be between March and October. Vesey-FitzGerald (1941) describes this species as breeding on four islands of the atoll (West North, East North, Grand Polyte, South) but not on Wizard, presumably during his visit between September and November 1937.

Towards the south end of Wizard, low bushes appear among the long grass and finally merge into dense clumps 2-3 m high, covered with thorny creepers and penetrable only with the greatest difficulty. These bushes were occupied by nesting Red-footed Boobies Sula sula, whose numbers were impossible to estimate with any accuracy but which were well in excess of 150 pairs. On the lagoon shore at least 20 pairs were nesting in a small clump of Avicennia mangrove, which on Aldabra is avoided as a nesting site. Those nests whose contents could be seen either contained eggs or were empty, while on Aldabra, and on Menai Island on Cosmoledo, most nests contained eggs or half-grown chicks. All the adults seen were of the white phase.

Along the dune ridge, and in clearings in the long grass to the north of the landing place on the lagoon shore, many fragmented skeletons and feathers of the Sooty Tern Sterna fuscata were found; Vesey-FitzGerald (1941) describes this species as nesting on Wizard. They clearly suffer heavy mortality, similar to that on Goelette Island, Farquhar Atoll (Stoddart and Poore 1970); whether this is from predation, starvation or disease on Cosmoledo is not known, but the most likely culprits would seem to be cats, of which two were seen and one shot, and which cause serious losses to Sooty Terns on Ascension Island (Ashmole 1963). Baker (1963) refers to a tern-breeding area at the north end of Wizard, and though no living Sooty Terns were seen on the island they were heard and seen over the ships at night, and a few were seen between Astove and Cosmoledo early on 5 March.

The other sea birds seen on Wizard were three Red-tailed and two Yellow-billed Tropicbirds Phaethon rubricauda and P. lepturus; two Black-naped Terns Sterna sumatrana; and a single female Great Frigate Bird Fregata minor. Honegger (unpublished) reported that P. rubricauda nests on Cosmoledo in March.

Diamond also covered the northern half of Menai Island, from the settlement round to the lagoon shore mangroves. Red-footed Boobies, many with half-grown chicks, were nesting in the mangroves, particularly the tall Rhizophora on the landward fringe. A few Frigate birds Fregata sp. were seen soaring over tall mangroves on Chauve-souris island; the only Frigate bird certainly identified on the atoll was a female Great Frigate bird Fregata minor harrying White Boobies on Wizard. At dusk there was a large flight of Red-footed Boobies in from the sea, flying

low and fast over the dunes and usually avoiding the attention of the few Frigate birds soaring in wait.

Stoddart and Poore noted soaring Frigates over the south end of Menai in September 1968, and large numbers of boobies on an island to the south of Menai. Piggott (1961) mentions large numbers of boobies on Grand Polyte, and also bird colonies on Pagoda and South Island, all of which need investigation.

The following list summarises the records of sea birds on Cosmoledo; for similar lists of the land and shore birds, see the accompanying paper by Benson (1970a).

Puffinus l'herminieri

Heard at night over the settlement on Menai; reported by local fishermen to Diamond.

Phaethon rubricauda

Said to breed by Vesey-FitzGerald (1941) and reported by Honegger (unpublished) on the nest in March. H.M.S. Owen reported this species over Menai (Bourne 1966), and Diamond saw three on Wizard.

Phaethon lepturus

Sight record by R. D. T. Gaymer on 1 October 1965; two seen by Diamond on Wizard.

Sula dactylatra

Reported breeding by Vesey-FitzGerald (1941) on West North, East North, Polyte and South Islands, and by Diamond on Wizard. Also recorded by H.M.S. Owen (Bourne 1966).

Sula sula

Reported by Vesey-FitzGerald (1941) on Menai, East North, Grand Polyte, Wizard and South Islands. Reported by Honegger (unpublished) breeding in trees on Grand Polyte, by Diamond in mangroves on Menai, and by Stoddart and Poore on island south of Menai. Gaymer (unpublished) found a large colony with many young, 1 October 1965, on Chauve-souris, 200 per annum reportedly being taken for food. Recorded by H.M.S. Owen in March (Bourne 1966); collected by Parker in September.

Sula leucogaster

Reported by locals to Diamond as breeding. Collected by Parker, 5 October 1967.

Fregata ariel

Reported by locals to Diamond as breeding. Said to breed on islets by Vesey-FitzGerald (1941).

Fregata minor

Diamond identified one female on Wizard; locally reported to breed. Said to breed on islets by Vesey-FitzGerald (1941).

Hydroprogne caspia

Sight, Vesey-FitzGerald (1941).

Sterna anaethetus

On islets in October (Vesey-FitzGerald 1941).

Sterna fuscata

Breeds on Wizard Island (Vesey-FitzGerald 1941; Diamond, this paper).

Sterna albifronsSterna sumatrana

2 seen by Diamond on Wizard, 1968.

Thalasseus bergii

Sight record by Gaymer, 1 October 1965.

Anous stolidus

Breeding on islets, according to Vesey-FitzGerald (1941).

Settlement

Little is known of the history of settlement on Cosmoledo. It is more hospitable than Aldabra and presumably more attractive to early sailors, though permanent settlement may have been hindered by lack of fresh water. Moresby (1822, 30) reported that "the Cosmoledo Isles are sometimes resorted to for fish, where a few blacks are left, who wait the vessels return". The atoll was settled by the time of a visit by Sebert Baty in 1895 (Bergne 1900). Two to three hundred coconuts had been planted, maize grew fairly well, and goats thrived in numbers. There was at that time a reservoir on Menai holding 1300 velts (1950 gallons) of water, and one iron roof for catchment, together with one roof and 500 velts (750 gallons) capacity on Wizard. There was also on Menai a "large iron pan in which one man is able to distill 6 velts (9 gallons) of water a day including wood cutting and carrying". It was said that the atoll could provide work for twelve labourers. When H. A'C. Bergne visited it in 1901 there were two men on Menai, though seventeen were left there in the season: nine to take turtle, six for fishing, and two for preparing fish and shell. James Spurs was in charge of the atoll, which had two pirogues, a corrugated iron house, and labourers' huts made from piled-up turtle carapaces. Bergne (1901) found that half a dozen goats on Menai were not doing well, in contrast to the rats. In a good season 5000 lb of maize could be produced, but there were frequent failures of the harvest. In addition to the 2 persons on Menai, there was one on Wizard, though no plantation, and four on Northeast. The exploitation of guano had already begun on Northeast Island: Bergne stated that 120 tons had already been removed, at Rs 60 per ton, and that 300-400 tons were left.

The only island now inhabited is Menai, where there is a settlement with water tanks, a manager's house, labourers' houses and a small cemetery. There are fishing huts on Wizard and some of the other islands.

Guano is no longer worked on Northeast Island, though several hundred tons remain in cavities; Baker (1963) also estimates reserves on Grand Polyte, not yet worked, at 3700 tons.

The goats formerly reported on Menai are no longer there, but are reported by Piggott (1961) for Northeast Island. Rabbits have been introduced on South Island, according to Dupont (1907) before 1906, though according to Honegger (unpublished) about 1930. Two cats were seen on Wizard in 1968.

Until 1903, when it was transferred to the new colony of Seychelles, Cosmoledo was administered as part of Mauritius: it still forms part of Seychelles, and was not included in the British Indian Ocean Territory in 1965. The atoll is now leased, with Aldabra and Assumption, by Mr H. Savy of Mahé, and is used primarily as a fishing station. There are few coconuts, and Piggott (1961) reported the average yield to be only two nuts per palm per annum.

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